

Y-12 National Security Complex Biological Monitoring and Abatement Program—2018 Calendar Year Report



Limited distribution. Not for public release. M. J. Peterson

T. J. Mathews

R. A. McManamay

R. T. Jett

N. J. Jones

J. G. Morris

M. W. Jones

A. M. Fortner

G. W. Morris

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Cover photo: Biological Monitoring and Abatement Program staff collecting fish in East Fork Poplar Creek, Oak Ridge, Tennessee. Photo taken on September 12, 2011, by J. Miles Cary/Knoxville News Sentinel. Used by permission.

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Environmental Sciences Division

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M. J. Peterson
T. J. Mathews
R. A. McManamay
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Fish communities

The fish communities in Bear Creek were sampled in spring and fall 2018 using established multiple pass depletion methods; results are reported in Tables A.1 and A.2. The fish communities generally have been relatively stable in terms of species richness across all sites (Figs. A.6 and A.7), with the lower sites experiencing a slight increase in species in the last 10 years. The site furthest downstream (BCK 3.3) continues to have species richness values higher than a smaller reference stream (Mill Branch kilometer [MBK] 1.6), but these values are substantially lower than those of a larger reference stream (Brushy Fork kilometer 7.6), indicating that there is still some improvement expected in the fish communities. The sample site in the middle section of Bear Creek (BCK 9.9) continues to maintain species richness comparable with the smaller reference stream conditions, aided perhaps in recent years by the bypass of the downstream weir near BCK 4.6 that allows more upstream migration of fish species. Recent remediation activities at the BCK 12.4 site to restore about 300 feet of the channel to a more natural state have the end goal of providing additional species diversity and density of sensitive species. BCK 12.4 and NT3 fish communities appear to have recovered from the summer of 2016 drought conditions. In general, the fish communities in these small headwater sites are easily influenced by sedimentation and siltation (e.g., construction activities), below-normal rainfall conditions, or contaminated groundwater plumerelated effects. Several species that regularly inhabit these areas are interdependent, and any impact that influences one species also could affect others. One example of this is the Tennessee dace (Chrosomus tennesseensis), which is listed in the state of Tennessee as "In Need of Management." This fish relies on other nest-building species such as large-scale stonerollers (Campostoma oligolepis) or creek chubs (Semotilus atromaculatus) for spawning habitat. Despite the drought conditions, the fish populations in all Bear Creek sites showed signs of recovery in 2018 samples.

Table A.1. Species richness, density (number of fish/m²), and biomass (g/m², in parentheses) for fish community samples from Bear Creek; Bear Creek North Tributary 3; and the reference streams Brushy Fork, Mill Branch, and Pinhook Branch, March/April 2018

Species	BCK 12.4	BCK 9.9	BCK 3.3	NT3	BFK 7.6	MBK 1.6	PHK 1.6
		Lar	npreys				
American brook lamprey	-	-	-	-	< 0.01	-	-
Lampetra appendix					(0.01)		
		Mi	nnows				
Largescale stoneroller	_	0.45	0.18	-	< 0.01	0.01	-
Campostoma oligolepis		(1.36)	(1.28)		(0.01)	(0.29)	
Bigeye chub	-	-	-	-	0.01	-	-
Hybopsis amblops					(0.01)		
Striped shiner	-	0.56	0.09	-	0.05	0.01	-
Luxilus chrysocephalus		(2.13)	(1.14)		(0.57)	(0.12)	
Fathead minnow	-	0.01	-	-	-	-	-
Pimephales promelas		(0.05)					
Scarlet shiner	-	-	0.01	-	0.02	-	-
Lythrurus fasciolaris			(0.01)		(0.01)		
Tennessee dace	0.06	< 0.01	-	-	-	-	0.25
Chrosomus tennesseensis	(0.04)	(<0.01)					(0.31)
Tennessee dace hybrid	-	-	-	-	-	-	0.01
							(0.01)

Table A.1 (continued)

Species	BCK 12.4	BCK 9.9	BCK 3.3	NT3	BFK 7.6	MBK 1.6	PHK 1.6
		Minnows	(continued)				
Western blacknose dace	2.20	0.30	0.06	0.47	< 0.01	0.02	0.49
Rhinichthys obtusus	(2.03)	(0.51)	(0.06)	(0.91)	(<0.01)	(0.09)	(1.13)
Creek chub	-	0.07	0.01	0.24	-	0.02	0.22
Semotilus atromaculatus		(0.66)	(0.02)	(1.04)		(0.14)	(0.98)
		Suc	ekers				
White sucker		0.06	-	-	-	0.01	-
Catostomus commersonii		(0.74)				(0.64)	
Northern hogsucker	-	-	0.02	-	< 0.01	-	-
Hypentelium nigricans			(0.18)		(0.26)		
Spotted sucker	-	-	-	-	< 0.01	-	-
Minytrema melanops					(0.24)		
Black redhorse	-	-	-	-	< 0.01	-	-
Moxostoma duquesnei					(0.65)		
Golden redhorse	-	-	-	-	< 0.01	-	-
Moxostoma erythrurum					(0.02)		
		Topm	iinnows				
Blackspotted topminnow	-	-	-	-	< 0.01	-	-
Fundulus olivaceus					(<0.01)		
		Scu	ılpins				
Banded sculpin	-	0.03	< 0.01	-	0.03	-	-
Cottus carolinae		(0.25)	(0.05)		(0.16)		
		Sun	fishes				
Rock bass	-	-	0.02	-	0.01	-	-
Ambloplites rupestris			(0.05)		(0.54)		
Redbreast sunfish	-	< 0.01	< 0.01	-	0.03	-	-
Lepomis auritus		(0.03)	(<0.01)		(0.33)		
Green sunfish	-	0.07	0.16	-	< 0.01	-	-
Lepomis cyanellus		(0.50)	(0.96)		(0.02)		
Hybrid sunfish	-	< 0.01	-	-	-	-	-
		(0.06)					
Warmouth	-	-	-	-	< 0.01	-	-
Lepomis gulosus					(<0.01)		
Bluegill	-	-	-	-	0.05	0.03	-
Lepomis macrochirus					(0.12)	(0.13)	
Longear sunfish	-	-	-	-	< 0.01	-	-
Lepomis megalotis					(0.03)		

Table A.1 (continued)

		Pe	rches				
Greenside darter	-	-	-	-	< 0.01	-	-
Etheostoma blenniodes					(0.01)		
Blueside darter	-	-	-	-	< 0.01	-	-
Etheostoma jessiae					(0.01)		
Stripetail darter	-	0.09	0.11	-	< 0.01	0.05	-
Etheostoma kennicotti		(0.14)	(0.12)		(0.01)	(0.09)	
Redline darter	-	-	-	-	< 0.01	-	-
Etheostoma rufilineatum					(<0.01)		
Snubnose darter	-	0.08	0.01	-	0.04	< 0.01	-
Etheostoma simoterum		(0.13)	(0.01)		(0.04)	(0.01)	
TOTAL							
Species richness	2	12	12	2	23	8	3
Density	2.26	1.74	0,67	0.71	0.27	0.14	0.96
Biomass	2.07	6.56	3.88	1.94	3.04	1.50	2.43

Notes: BCK = Bear Creek kilometer; NT3 = Bear Creek North Tributary 3; BFK = Brushy Fork kilometer; MBK = Mill Branch kilometer; PHK = Pinhook Branch kilometer.

Table A.2. Species richness, density (number of fish/m²), and biomass (g/m², in parentheses) for fish community samples from Bear Creek; Bear Creek North Tributary 3; and the reference streams Brushy Fork, Mill Branch, and Pinhook Branch, September/October 2018

Species	BCK 12.4	BCK 9.9	BCK 3.3	NT3	BFK 7.6	MBK 1.6	PHK 1.6
		Lan	npreys				
American brook lamprey	- -	-	-	-	0.08	-	-
Lampetra appendix					(0.53)		
		Miı	nows				
Largescale stoneroller	0.21	0.53	0.11	_	0.08	0.05	_
Campostoma oligolepis	(0.69)	(1.50)	(0.49)		(0.33)	(0.58)	
Spotfin shiner	-	-	-	-	< 0.01	-	-
Cyprinella spiloptera					(<0.01)		
Bigeye chub	-	-	-	-	0.05	-	-
Hybopsis amblops					(0.10)		
Striped shiner	-	0.81	0.10	-	0.22	0.06	-
Luxilus chrysocephalus		(3.11)	(0.60)		(1.72)	(1.02)	
Scarlet shiner	-	-	0.07	-	0.01	-	-
Lythrurus fasciolaris			(0.17)		(0.03)		
Tennessee dace	0.46	< 0.01	-	-	-	-	0.78
Chrosomus tennesseensis	(0.41)	(<0.01)					(1.16)
Hybrid Tennessee dace	-	-	-	-	-	-	0.02
							(0.03)

Table A.2 (continued)

Pathead minnow - 0.14 -	Species	BCK 12.4	BCK 9.9	BCK 3.3	NT3	BFK 7.6	MBK 1.6	PHK 1.6
Primephales promelas			Minnows	(continued)	1000000			
Western blacknose dace 0.85 0.39 0.04 0.62 0.01 0.13 1.14 Rhinichthys obtusus 0.93 0.52 0.08 0.124 0.001 0.03 0.77 Creek chub 0.29 0.07 0.01 0.22 0.01 0.05 0.77 Emotilus atromaculatus 0.76 0.66 0.67 0.09 0.14 0.02 0.57 Emotilus atromaculatus 0.76 0.05 0.01 0.22 0.01 0.05 0.77 Emotilus atromaculatus 0.76 0.05 0.01 0.02 0.57 Emotilus atromaculatus 0.76 0.05 0.01 0.01 0.01 0.01 0.01 Emotilus atromaculatus 0.667 0.001 0.005 0.53 0.04 White sucker - 0.05 0.01 0.05 0.05 0.53 Spotted sucker - 0.0 0.03 0.04 0.01 0.01 0.05 Minyarema melanops - 0.03 0.04 0.01 0.01 0.05 Minyarema melanops - 0.03 0.04 0.01 0.01 0.05 Minyarema melanops - 0.03 0.04 0.01 0.01 0.05 Moxostoma diaquesmei - 0.07 0.07 0.03 0.04 0.01 0.05 Moxostoma diaquesmei - 0.04 0.01 0.04 0.01 0.08 Fundulus olivaceus - 0.01 0.00 0.00 0.00 Fundulus olivaceus - 0.01 0.00 0.00 0.00 0.00 Fundulus olivaceus - 0.04 0.01 0.00 0.01 0.01 Gambusia affinis - 0.04 0.01 0.06 0.01 0.01 0.00 Cottus carolinae - 0.04 0.01 0.06 0.01 0.01 0.00 0.00 Cottus carolinae - 0.04 0.01 0.06 0.01 0.01 0.00 0.	Fathead minnow	Construction that there is a representation of a state of the state of	0.14	Contraction (the allowed business than the allowed business that the allowed business that the allowed business than the a	-	- Construct has Chesther's Construct has Chesther's Construct that	the allowed has the constituted the attractions of the allowed has the constituted the attraction of t	man Charles Charles Charles Charles Charles Charles Charles Charles Charles
Refinichthys obtusus Q.93 Q.93 Q.05 Q.08 Q.24 Q.01 Q.03 Q.05 Q.77 Creek chub Q.29 Q.07 Q.01 Q.22 Q.01 Q.05 Q.77 Creek chub Q.29 Q.07 Q.01 Q.02 Q.01 Q.05 Q.77 Creek chub Q.06 Q.07 Q.01 Q.02 Q.05 Q	Pimephales promelas		(0.16)					
Creek chub 0.29 0.07 0.01 0.22 0.01 0.05 0.77 Semotilus atromaculatus (0.76) (0.67) (0.09) (1.14) (0.02) (0.57) (1.68) Substructure Vibrites sucker Catostomus commersonii 0.05 0.01 - 0.01 - Spotted sucker - - - 0.01 - 0.01 - Minyrema melanops - - - 0.03 - 0.04 0.01 - Morthern hogsucker - - 0.03 - 0.04 0.01 - Hypertelium nigricans - - 0.03 - 0.04 0.01 - Black redinorse -	Western blacknose dace	0.85	0.39	0.04	0.62	< 0.01	0.13	1.14
Semotilus atromaculatus	Rhinichthys obtusus	(0.93)	(0.52)	(0.08)	(1.24)	(<0.01)	(0.32)	(1.27)
Suckers	Creek chub	0.29	0.07	0.01	0.22	0.01	0.05	0.77
White sucker - 0.05 <0.01	Semotilus atromaculatus	(0.76)	(0.67)	(0.09)	(1.14)	(0.02)	(0.57)	(1.68)
Catostomus commersonii (0.67) (0.01) (0.05) (0.53) Spotted sucker			Suc	ckers				
Spotted sucker	White sucker	-	0.05	< 0.01	-	< 0.01	0.01	-
Minytrema melanops (0.08) Northern hogsucker - - 0.03 - 0.04 0.01 - Hypentellum nigricans (0.75) (1.17) (0.28) Black redhorse - - 0.01 - - Moxostoma duquesnei - - - 0.01 - - Golden redhorse - - - 0.01 - - - Moxostoma duquesnei - - - 0.01 - - - - 0.01 - - - - - - 0.01 - </td <td>Catostomus commersonii</td> <td></td> <td>(0.67)</td> <td>(0.01)</td> <td></td> <td>(0.05)</td> <td>(0.53)</td> <td></td>	Catostomus commersonii		(0.67)	(0.01)		(0.05)	(0.53)	
Northern hogsucker - 0.03 - 0.04 0.01 - Hypentelium nigricans (0.75) (1.17) (0.28) Black redhorse - - - 0.01 - - Moxostoma duquesnei -	Spotted sucker	-	-	_	-	< 0.01	-	-
Hypentelium nigricans (0.75) (1.17) (0.28) Black redhorse 0.01 Moxostoma duquesnei (0.14) (0.14) Golden redhorse 0.01 Moxostoma erythrurum (0.08) Topmimows Topmimows Blackspotted topminnow 0.01 Fundulus olivaceus Livebearers Western mosquitofish 0.01 - 0.01 Gambusia affinis - 0.04 0.01 - 0.06 Cottus carolinae - 0.04 0.01 - 0.06 Cottus carolinae - 0.04 0.01 - 0.01 0.01 - Cottus carolinae - 0.04 0.01 - 0.01 0.01 - Ambloplites rupestris - 0.04 0.01 - 0.06 0.01 - Ambloplites rupestris - 0.04 0.01 - 0.06 0.01 - Lepomis auritus - 0.04 0.01 - 0.06 0.01 - Lepomis cyanellus - 0.12 0.15 - 0.02 0.01 - Lepomis cyanellus - 0.12 0.15 - 0.02 0.01 - Lepomis gulosus - 0.01 0.01 - Lepomis gulosus - 0.02 0.05 0.15 - Lepomis macrochirus - 0.0 0.01 - Lepomis macrochirus - 0.0 0.05 0.15 - Lepomis macrochirus - 0.0 0.01 - Lepomis macrochirus - 0.01 0.01 - Lepomis macrochirus - 0.01 0.01 - Lepomi	Minytrema melanops					(0.08)		
Black redhorse	Northern hogsucker	-	-	0.03	-	0.04	0.01	-
Moxostoma duquesnei	Hypentelium nigricans			(0.75)		(1.17)	(0.28)	
Golden redhorse -	Black redhorse	-	-	-	-	0.01	-	-
Moxostoma erythrurum	Moxostoma duquesnei					(0.14)		
Blackspotted topminnow Country	Golden redhorse	-	-	-	-	< 0.01	-	-
Blackspotted topminnow - - - - <0.01 - - -	Moxostoma erythrurum					(0.08)		
Control Cont			Topn	innows				
Civebearers Civebearers Civebearers	Blackspotted topminnow	-	-	-	-	< 0.01	-	-
Western mosquitofish - - 0.01 - <0.01 - - Gambusia affinis (<0.01) (<0.01) (<0.01) -	Fundulus olivaceus					(0.01)		
Combusia affinis Combusia af			Livel	bearers				
Sculpins Sculpins Banded sculpin Cottus carolinae (0.20)	Western mosquitofish	-	-	0.01	-	< 0.01	-	-
Banded sculpin - 0.04 0.01 - 0.06 - - Cottus carolinae (0.20) (0.05) (0.17) Rock bass	Gambusia affinis			(<0.01)		(<0.01)		
Cottus carolinae (0.20) (0.05) (0.17) Sunfishes Rock bass - 0.04 0.01 - 0.01 0.01 - Ambloplites rupestris (0.34) (0.09) (0.63) (0.95) - Redbreast sunfish - 0.04 0.01 - 0.06 0.01 - Lepomis auritus (0.64) (0.17) (1.10) (0.28) - <t< td=""><td></td><td></td><td>Sci</td><td>ılpins</td><td></td><td></td><td></td><td></td></t<>			Sci	ılpins				
Sunfishes Sunfishes Rock bass -	Banded sculpin	_	0.04	0.01	_	0.06	_	-
Rock bass - 0.04 0.01 - 0.01 0.01 - Ambloplites rupestris (0.34) (0.09) (0.63) (0.95) Redbreast sunfish - 0.04 0.01 - 0.06 0.01 - Lepomis auritus (0.64) (0.17) (1.10) (0.28) - Green sunfish - 0.12 0.15 - 0.02 0.01 - Lepomis cyanellus (1.25) (0.98) (0.17) (0.37) - Warmouth - - - - - 0.01 - Lepomis gulosus - - - - 0.05 0.15 - Lepomis macrochirus - - - - - 0.01 - Hybrid sunfish - - - - - - 0.01 -	Cottus carolinae		(0.20)	(0.05)		(0.17)		
Ambloplites rupestris (0.34) (0.09) (0.63) (0.95) Redbreast sunfish - 0.04 0.01 - 0.06 0.01 - Lepomis auritus (0.64) (0.17) (1.10) (0.28) Green sunfish - 0.12 0.15 - 0.02 0.01 - Lepomis cyanellus (1.25) (0.98) (0.17) (0.37) (0.37) Warmouth - - - - - 0.01 - Lepomis gulosus - - - - 0.05 0.15 - Lepomis macrochirus - - - - - 0.05 0.15 - Hybrid sunfish - - - - - - 0.01 -			Sun	fishes				
Redbreast sunfish - 0.04 0.01 - 0.06 0.01 - Lepomis auritus (0.64) (0.17) (1.10) (0.28) Green sunfish - 0.12 0.15 - 0.02 0.01 - Lepomis cyanellus (1.25) (0.98) (0.17) (0.37) Warmouth - - - - - 0.01 - Lepomis gulosus (0.20) Bluegill - - - - 0.05 0.15 - Lepomis macrochirus - - - - - 0.01 - Hybrid sunfish - - - - - - 0.01 -	Rock bass	-	0.04	0.01	-	0.01	0.01	-
Lepomis auritus (0.64) (0.17) (1.10) (0.28) Green sunfish - 0.12 0.15 - 0.02 0.01 - Lepomis cyanellus (1.25) (0.98) (0.17) (0.37) Warmouth - - - - - 0.01 - Lepomis gulosus - - - - 0.05 0.15 - Lepomis macrochirus - - - - - 0.01 - Hybrid sunfish - - - - - 0.01 -	Ambloplites rupestris		(0.34)	(0.09)		(0.63)	(0.95)	
Green sunfish - 0.12 0.15 - 0.02 0.01 - Lepomis cyanellus (1.25) (0.98) (0.17) (0.37) Warmouth - - - - - 0.01 - Lepomis gulosus - - - - 0.05 0.15 - Bluegill - - - - 0.05 0.15 - Lepomis macrochirus - - - - - 0.01 - Hybrid sunfish - - - - - - 0.01 -	Redbreast sunfish	-	0.04	0.01	-	0.06	0.01	-
Lepomis cyanellus (1.25) (0.98) (0.17) (0.37) Warmouth - - - - - 0.01 - Lepomis gulosus - - - - 0.05 0.15 - Bluegill - - - - 0.05 0.15 - Lepomis macrochirus - - - - - 0.01 - Hybrid sunfish - - - - - 0.01 -	Lepomis auritus		(0.64)	(0.17)		(1.10)	(0.28)	
Warmouth - - - - - 0.01 - Lepomis gulosus - - - - - 0.05 0.15 - Bluegill - - - - - 0.05 0.15 - Lepomis macrochirus - - - - - - 0.01 - Hybrid sunfish - - - - - - 0.01 -	Green sunfish	-	0.12	0.15	-	0.02	0.01	-
Lepomis gulosus (0.20) Bluegill - - - - 0.05 0.15 - Lepomis macrochirus - - - - - 0.51) (1.53) Hybrid sunfish - - - - - 0.01 -	Lepomis cyanellus		(1.25)	(0.98)		(0.17)	(0.37)	
Bluegill 0.05 0.15 - Lepomis macrochirus	Warmouth	-	-	-	-	-	0.01	-
Lepomis macrochirus (0.51) (1.53) Hybrid sunfish - - - - 0.01 -	Lepomis gulosus						(0.20)	
Hybrid sunfish 0.01 -	Bluegill	-	-	-	-	0.05	0.15	-
	Lepomis macrochirus					(0.51)	(1.53)	
(0.22)	Hybrid sunfish	-	-	-	-	-	0.01	-
							(0.22)	

Table A.2 (continued)

Species	BCK 12.4	BCK 9.9	BCK 3.3	NT3	BFK 7.6	MBK 1.6	PHK 1.6
		Sunfishes	(continued)				
Spotted bass	-	-	-	-	-	< 0.01	-
Micropterus punctulatus						(0.04)	
Largemouth bass	-	-	0.01	-	-	-	-
Micropterus salmoides			(0.05)				
		Per	rches				
Greenside darter	_	-	-	-	< 0.01	-	-
Etheostoma blenniodes					(0.05)		
Blueside darter	-	-	-	-	0.02	-	-
Etheostoma jessiae					(0.03)		
Stripetail darter	-	0.11	0.05	-	0.01	0.02	-
Etheostoma kennicotti		(0.10)	(0.04)		(0.01)	(0.01)	
Redline darter	-	-	-	-	0.01	-	-
Etheostoma rufilineatum					(0.01)		
Snubnose darter	-	0.10	0.06	-	0.05	-	-
Etheostoma simoterum		(0.13)	(0.06)		(0.05)		
TOTAL					grander bee		
Species richness	4	13	15	2	25	13	3
Density	1.81	2.45	0.68	0.85	0.80	0.52	2.71
Biomass	2.78	9.30	3.64	2.38	6.98	6.91	4.14

Notes: BCK = Bear Creek kilometer, NT3 = Bear Creek North Tributary 3; BFK = Brushy Fork kilometer, MBK = Mill Branch kilometer, PHK = Pinhook Branch kilometer.

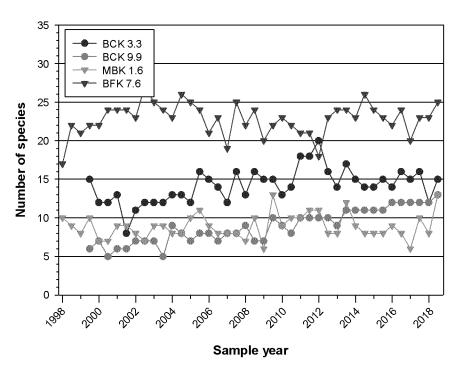


Fig. A.6. Species richness (number of species) in samples of the fish communities in lower to middle Bear Creek and the Brushy Fork and Mill Branch reference streams, 1998–2018.

Interruptions in data lines indicate no results are available for those periods.

(Notes: BCK = Bear Creek kilometer; BFK = Brushy Fork kilometer; MBK = Mill Branch kilometer.)

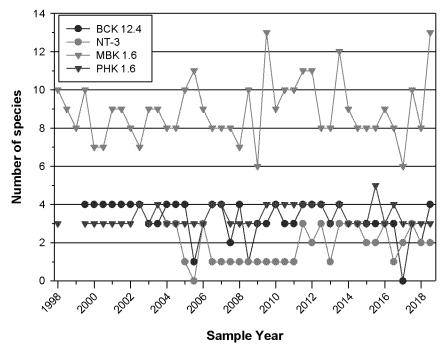


Fig. A.7. Species richness (number of species) in samples of the fish communities in upper Bear Creek, Bear Creek North Tributary 3, and the Mill Branch and Pinhook Branch reference streams, 1998–2018. Interruptions in data lines indicate no results are available for those periods.

(Notes: BCK = Bear Creek kilometer; NT3 = Bear Creek North Tributary 3;

MBK = Mill Branch kilometer; PHK = Pinhook Branch kilometer.)